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ABSTRACT

The paper discusses research on cognitive processing of disabled readers (mean age 9 years) within a brain-behavior framework and offers some projections into the future. The author focuses on children with severe reading disablility or reading retardation although reference to "backward" readers is also included. The delineation of subgroups of disabled readers, the explication of perceptual versus verbal deficits in these children, and especially differential remediation are seen as necessary continuing tasks for the years ahead. (Author/SBH)

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First World Congress on Future Special Education

June, 1978, Stirling, Scotland

Paper read at Panel 30 "Understanding Reading Retardation : Cognitive Aspects"

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Abstract

This paper will discuss some of the present writer's work into cognitive processing of disabled readers within a brain-behavior framework and will hazard some projections into the future. The focus is on children with severe reading disability or reading retardation although reference to "backward" readers is also included. The delineation of subgroups of disabled readers, the explication of perceptual versus verbal deficits in these children and especially differential remediation are seen as necessary continuing tasks for the years ahead.

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Paper read at Panel 30 "Understanding Reading Retardation : Cognitive Aspects"

Che Kan LEONG, Ph.D., Institute of Child Guidance and Development, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

In this, the first World Congress on Future Special Education organized by the Council for Exceptional Children, one is reminded of a similar futuristic undertaking by a committee appointed by the prestigious U.S. National Academy of Sciences. The projections of that group into the year 2,000 were published some ten years ago in Daedalus (Bell, 1967). "Crystal-ball gazing" into the future is necessarily Janus-like, with one face looking back and one face looking forward. One would therefore assume that the mandate for participants of this Congress is both retrospective and cautiously prospective.

This paper will discuss some of the present writer's work into cognitive processing of disabled readers within a brain-behavior framework and will hazard some projections into the future. The focus is on children with severe reading disability or reading retardation although reference to "backward" readers is also included. The delineation of subgroups of disabled readers, the explication of perceptual versus verbal deficits in these children and especially differential remediation are seen as necessary continuing tasks for the years ahead.

Cognitive Processing of Disabled Readers

In general, studies of cognitive processing of disabled readers

deal with two broad groups of children : below average readers and those with developmental dyslexia. The reference battery has been subtests of the Wechsler Intelligence Scale for Children (WISC) or its downward extension the Wechsler Pre-School and Primary Scale of Intelligence (WPPSI). Some studies have also added reading related tasks involving auditory-motor activities (e.g. sound blending, articulation); visual-motor tasks (e.g. visual retention); and decoding skills involving matching tasks for letters, letter strings, syllables and words. The research design is usually correlational in nature. The methodology used is mainly the R-technique of factor analysis which groups together tests on which children exhibit similar patterns of performance. Also sometimes used are cluster analysis which aims at taxonomic classification and more recently the Q-technique of factor analysis, which is essentially a "transpose" method of grouping together children with similar patterns of test scores. Myklebust, Bannochie and Killen (1971, p. 227) summed up well their findings, and indirectly those of others, of cognitive processing of learning disabled children : "A learning disability affects the organization of the intellect; hence, cognition itself is modified. The mental abilities of learning-disability children are structured differently. By implication, the processes whereby they learn, whereby they organize experience, also are different." Studies of cognitive structure or pattern thus aim at finding out more about the processes of learning of disabled readers.

Luria's Postulate of Information Synthesis

The present writer's pattern studies of severely disabled readers are predicated on the neuropsychological model of information processing

of Luria (1966a, 1966b, 1973). This model is operationalized by Das (see review by Das, Kirby, & Jarman, 1975). Very briefly, Luria conceives of language including reading as the product of "complex adaptive activity of a whole system". The apparatus for this is the upper associative layers of the cerebral cortex. Luria distinguishes between three principal functional units of the brain. Simply stated, there is a unit for regulating tone or waking; there is a unit for obtaining, processing and storing information arriving from the outside world and a unit for programming, regulating and verifying mental activities. Luria emphasizes that any conscious activity is always a complex functional system and takes place through the combined concerted working of all three brain units.

Dealing with language disorders including reading, writing and arithmetic disorders, Luria postulates two basic forms of integrative activities. These are the simultaneous (primarily spatial, groups) and successive (primarily temporally organized series) syntheses at the perceptual, memory and intellectual levels. For example, simultaneous synthesis at the perceptual level may be manifested in : copying of geometric figures, drawing of a map, performance on Kohs Block; and at the memory level in : "arithmetic difficulties" and "grammatical structure involving arrangement of elements into one simultaneous scheme". In successive synthesis, examples are counting sequences of tapping, digit span and serial learning such as drawing "O + + -" while keeping the correct order. In Luria's terms, simultaneous-successive syntheses can be identified with the functions of specific parts of the cortex — the occipital-parietal area has evolved to be mainly responsible for simultaneous synthesis; the successive

is located in the anterior regions, particularly in the fronto-temporal area. Both of these are concerned with coding and storage of information. The Luria model assumes that the two syntheses of information processing are available to the individual depending on his habitual mode of activities and the demand of the task.

Tests of the Postulate

Retarded Readers

The subjects for the first study were 58 disabled readers (all boys) with a mean chronological age of 111.07 months and a mean Lorge-Thorndike non-verbal IQ of 102.45. All of these boys had been diagnosed as "retarded" in reading by two and a half grades or more, but were otherwise of average intelligence and free from gross emotional, visual and auditory disabilities. These severely disabled readers were compared with a control group of 58 above-average readers drawn from the same schools and equated on age, general ability and were of the same sex. There was no significant difference between the two groups on CA and IQ as tested conjointly with a Hotelling T^2 test.

Of the eight tasks used to tap simultaneous-successive processing six tasks with minor modifications were from the battery consistently used by Das (Das et al., 1975) and the remaining two tasks were subtests from the Revised Illinois Test of Psycholinguistic Abilities (Kirk, McCarthy, & Kirk, 1968). The six Das tasks were : Raven's Coloured Progressive Matrices, Figure Copying Test, Memory-for-Designs Test, Cross-Modal or Auditory-Visual Coding, Visual Short-Term Memory Task, and Auditory Serial Recall. The ITPA tasks were : Visual Sequential Memory subtest and Auditory Sequential Memory subtest.

For each of the experimental and contrast groups the 8 simultaneous-successive tasks were subjected to two methods of factor analysis -- a principal component analysis and an alpha factor analysis -- to achieve "method independent" results. Details of findings are reported elsewhere (Leong, 1976). Very briefly, Raven's Coloured Progressive Matrices, Figure Copying and Memory-for-Designs loaded on the simultaneous component/factor in the Luria-Das terminology. Auditory Serial Recall and ITPA Auditory Sequential Memory loaded on the successive component/factor. The pattern of simultaneous-successive dimensions was similar but not identical in the two groups as shown by a factor matching technique and as shown by the shifting of other tasks from one vector space to the other. This similarity of patterns is taken to demonstrate Luria's "double dissociation principle" which states in essence that focal pathological locus in the cerebral cortex will disturb the successful performance of some psychological processes but will leave others intact (Luria, 1966a, 1966b, 1973).

Below Average Readers

The subjects for the second study consisted of 76 children completing grade 2, who were randomly selected from three schools. There were 35 boys and 41 girls with a mean chronological age of 94.83 months and a standard deviation of 6.04 months for the total group. This was dichotomized into two sub-groups of 38 above average (AA) readers and 38 below average (BA) readers on the basis of the aggregate of scores on the Schonell Word Recognition Test and the Gates-McKillop Oral Reading (of paragraphs) subtest. On the Schonell the mean reading age for the above average readers was 108.23 months and for the below average readers was 90.74 months. On the Gates-McKillop, which yields more generous results, the reading age for

the above average sub-group was 4.83 grades and for the below average readers 3.68 grades. The two sub-groups differed significantly on their word recognition and paragraph reading abilities as tested conjointly with the Hotelling T^2 test.

Of the 8 tasks used in the first study Visual Short-Term Memory and the ITPA Visual Sequential Memory subtest were not used for this study. Added to the six remaining tests was a 24-item Sentence Repetition task modified from that of Clay (1971). As with the first study the 7 tasks were subjected to a principal component analysis and an alpha factor analysis.

Results of the factor analyses of the two groups of above average and below average readers further confirm the simultaneous-successive patterns. Raven's, Figure Copying, Memory-for-Designs and Auditory-Visual Coding all loaded on the simultaneous dimension; while Auditory Serial Recall, ITPA Auditory Sequential Memory and Sentence Repetition all loaded on the successive dimension. For each sub-group there was no significant difference between the dimensions obtained from the two different factor models. There was, however, significant difference between the two groups. Figure 1 shows the simultaneous and successive factor scores for the 76 readers. It can be seen that as a group the below average readers lagged behind their peers, especially in the successive dimension.

Insert Figure 1 about here

The studies of retarded and below average readers taken together demonstrate what Luria (1973, p. 41) suggests : "apparently identical psycho-

logical processes can be distinguished and apparently different forms of mental activity can be reconciled."

Discussion

The Luria framework is grounded in a theoretical formulation of the brain's functional organization governing psychological processes. The approach thus goes beyond the profile analyses of WISC or WPPSI subtests. It is to be distinguished from so-called "neurological organization" in recapitulating the ontogeny of development, which has not been shown to help disabled readers. While one must guard against "neurologizing", it is important for educators to understand how brain function or dysfunction might affect reading. Equally important is it for our counterparts in the medical profession to know something of learning in children. It is significant to note that the National Society for the Study of Education has just published the 77th Yearbook and the first volume in that series on neurosciences for educators. The work entitled Education and the Brain (Chall & Mirsky, 1978) is a signal recognition of the increasing impact made by the neurosciences on the diagnosis and treatment of children with severe difficulties in learning academic skills. One may safely predict that a deeper understanding of the mechanisms of reading retardation will have to come from a closer working relationship between the neurosciences and the social sciences including the science of teaching. In this regard, Critchley (1974) suggested that one promising line of research into reading retardation, barely touched on yet, is biochemical. He hazarded the projection to the day when the chemical reaction of myelination of brain structures might be capable of stimulation by artificial means and if so learning would be facilitated.

The Luria postulate also carries with it the implicit emphasis of the qualitative over and above the quantitative aspects of performance. Attention is on how a function suffers rather than what functions are defective or deficient. Underlying factors rather than symptoms are studied. This is likened to the approach of factor analysis in both integrating a number of tasks and later differentiating them to determine underlying processes. In an analysis of the qualitative performance of the 58 retarded readers on the simultaneous-successive tasks there was evidence that these children were deficient in using rules to solve these tasks (Leong, 1975). Their poor performance on the Figure Copying Test could be attributed to their lack of understanding of construction rules rather than problems in visual perception or in the motor act of copying. Likewise, their difficulties with Raven's Progressive Matrices relate to their reliance on concrete operation of visual images rather than formal operation in seeing relationships and educing correlates (see also Hunt, 1974). This qualitative interpretation of individual performance will enhance the inference of processes from factor loadings and factor patterns of groups. It will also highlight the different procedures a child can draw on in solving a cognitive task and the importance of analyzing his learning strategies, whether simultaneous or successive.

The factor analytic studies of retarded and backward readers provide some empirical evidence that what is apparently the same cognitive task is "operated" on differentially by groups of children varying in reading proficiency. The small battery of tasks has been shown to be effective in differentiating retarded readers from their controls and below average readers from above average ones. This differentiation on the basis of structure and process gives more insight into these readers than is possible with the level-of-performance comparing good and poor readers.

Kirby and Das (1977) have further shown that both simultaneous and successive processing is necessary, but neither, by itself, is sufficient, for high performance in reading and intelligence tests. The trend is a move towards more refined classification of subgroups of retarded readers. Early studies have tended to emphasize modality preferences of these children. Examples are the "visual dyslexics" and "auditory dyslexics" of Johnson and Myklebust (1967) and the dyseidetic and dysphonetic dyslexics with an interm diate group of dysphonetic-dyseidetic dyslexics of Boder (1971). Current work is directed towards more language related skills and provides therefore a closer link with remediation. Mattis, French and Rapin (1975), for example, have found these subgroups of developmental dyslexics : those with language disorder, those with articulatory and graphomotor dys-coordination and those with visuo-constructional difficulties. A recent Q-technique factor analysis by Doehring and Hoshko (1977) of children with "reading problems" is in a similar direction. They found three subgroups characterized respectively by : slow oral word reading, slow auditory-visual letter association and slow auditory-visual association of words and syllables. The usefulness of statistical methods of profile analysis is thus further shown. The Luria model can be pursued with advantage with a more refined battery of perceptual, cognitive and especially linguistic tasks.

The refined classification of subgroups also shows that perceptual training and language programming have their place for different retarded readers. Those who decry the role of intersensory integration and temporal order perception as underpinnings of reading and who attribute

reading retardation to linguistic deficits seem to overlook the heterogeneous nature of retarded readers. Vellutino (1977) has recently summarized his and other studies on sensory perception in disabled readers and argued strongly for a "verbal processing deficit" as a convincing explanation of specific reading disability. To the extent that reading retardation is a residual disorder or that part of reading difficulties which we have not been able to explain fully, then attention, perception, memory, cognition and language all contribute to the variance. Language deficit is thus one component, albeit an important one, accounting for reading dysfunction. It is also significant that in their recent formulation respectively on visual and auditory perception and imperception Frostig (1975) and Wepman (1975) have emphasized the integration of sensory functions in a neuropsychological and developmental context. What is needed is to explicate the roles of perceptual, memorial, cognitive and linguistic skills as they interact with different components of reading and with different processes of reading.

A decade ago, Critchley (1968) suggested some seventeen different areas worthy of further exploration in reading retardation. These areas included early and efficient diagnosis, delineation of speech and language development, detailed case studies and follow-ups and studies of theory-based programs. Continued work and progress in these and other areas outlined earlier should bring us to the day, hopefully well before the end of the next decade, that almost all children will "read, mark, learn, and inwardly digest".

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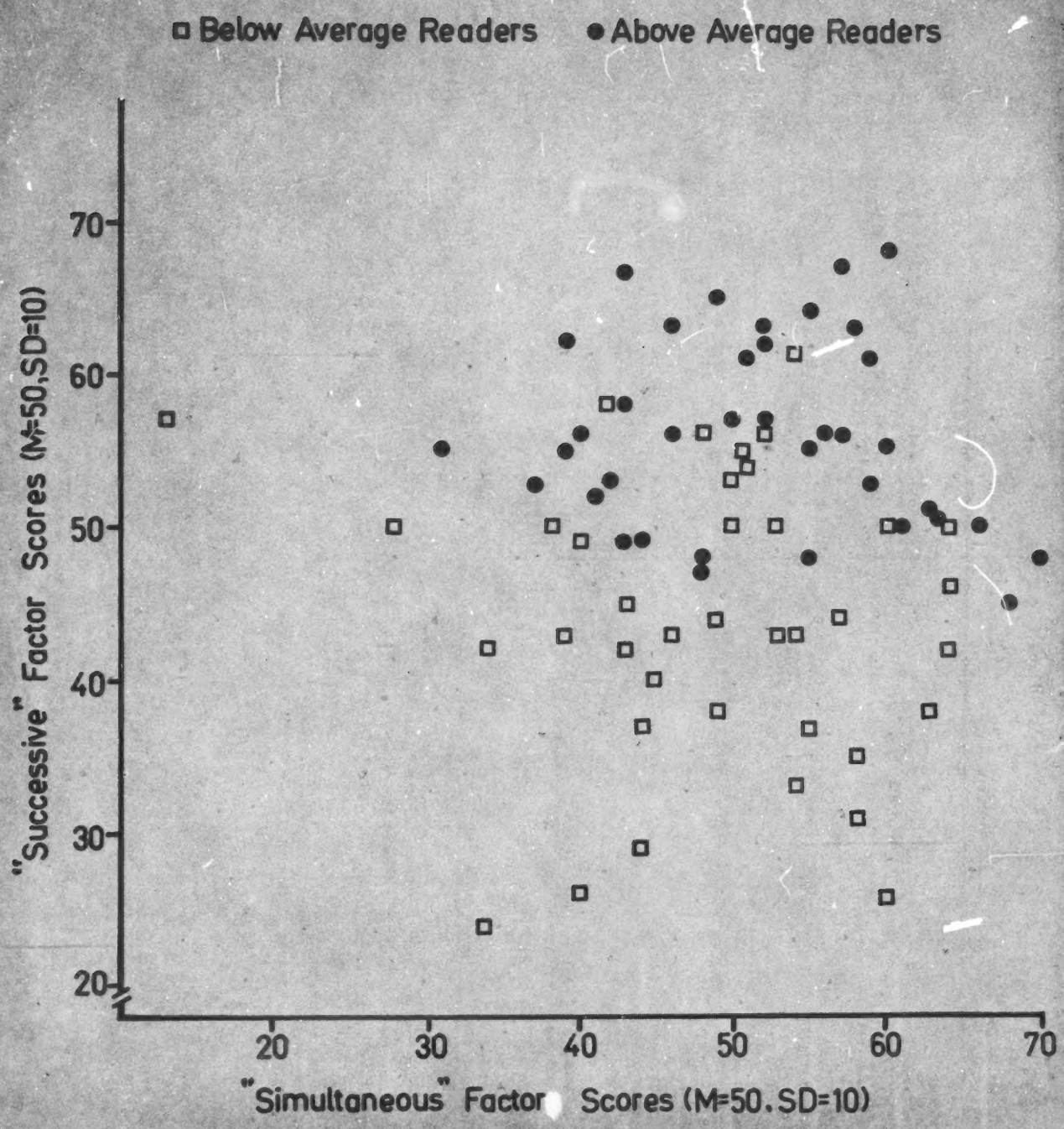
Figure Caption

Figure 1 Scattergram of "simultaneous" and "successive" factor scores for above-average and below-average groups (N = 38 each).


□ Below Average Readers
● Above Average Readers
"Successive" Factor Scores (M=50,SD=10)
70
60
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60
70
"Simultaneous" Factor Scores (M=50, SD=10)

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